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ABSTRACT

GRADES OR AGES: 7-12. SUBJECT MATTER: Mathematics laboratory. ORGANIZATION AND PHYSICAL APPEARANCE: The guide has 10 sections: (1) introduction, explaining the nature of the student and the duties of the teacher; (2) personnel and their duties; (3) physical characteristics of the lab; (4) testing program; (5) evaluation procedure; (6) record keeping; (7) types of instruction; (8) initial organization; (9) description of the program; (10) recommendations for equipping a secondary mathematics laboratory classroom. The guide is xeroxed and spiral-bound with a soft cover. OBJECTIVES AND ACTIVITIES: No detailed objectives are set out, but the program is designed to meet the needs of the low achiever through the laboratory approach. Examples of activities are given in section 9. INSTRUCTIONAL MATERIALS: Section 10 contains a tentative listing of equipment divided into two categories--essential and desirable. STUDENT ASSESSMENT: Procedures for evaluation are set out in sections 5 and 6. (MBM)

ED048143

THE SECONDARY MATHEMATICS LABORATORY

STRATEGY MANUAL

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PREFACE

The Secondary Mathematics Laboratory Strategy Manual reflects Brevard County's attempt to meet the needs of the low achiever through the laboratory approach. This approach, combined with reduced class size and a competent, motivated teacher of mathematics, should result in improved mathematics programs for the uncommitted learner.

The laboratory approach has evolved over the past two years and the manual represents the collective thinking of many individual teachers and administrators. It is published as a tentative document to provide direction to the development of the mathematics laboratory in the secondary schools.

- Thomas G. Etheredge, Jr.

SP007005

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THE SECONDARY MATHEMATICS LABORATORY STRATEGY MANUAL

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I. INTRODUCTION

The purpose of this manual is to serve as a guideline for individualizing mathematics through a laboratory approach. It should be stressed that this is only a guide and that the final implementation of an effective lab program depends on each teacher's creative approach to teaching.

Any teaching strategy should be based on the needs and interests of the students. In Brevard County, the mathematics laboratory program is designed primarily for those students enrolled in Phase I and Phase II math classes.

A. The Nature of the Lab Student

This mathematics laboratory program is intended to reach reluctant learners. Experience has shown that they share the following common characteristics.

Phase I

1. Deficient in reading
2. Deficient in verbal communication
3. Negative attitude toward school
4. Dependent upon continuous teacher direction
5. Lack of motivation in subject matter
6. Requires immediate supervision of work
7. Oriented to concrete or "reality" centered activities
8. Failure syndrome
9. Needs immediate and continuous reinforcement and/or attention from the teacher
10. Low retention
11. Adjusts social/emotional reactions to unfamiliar situations slowly
12. Short attention span
13. Prefers visual and/or manipulative materials
14. Responds well to routine or familiar tasks
15. Has limited vocabulary and difficulty in adjusting speech patterns to different audiences

A. The Nature of the Lab Student (Continued)

Phase I (Continued)

16. Low achievement

17. Needs continuous reassurance of relationship to the subject matter and/or the teacher

18. Responds better to highly structured situations, rather than ambiguous ones

Phase II

1. Below 7th grade reading level

2. May be either brash and overcompensating or reticent and retiring in class

3. Verbally proficient within restricted vocabulary

4. Little technical background in subject matter

5. Usually displays aptness in peer group sociability

6. Responds well to manipulative tasks

7. Not self confident with subject matter

8. Restricted, but expanding, vocabulary

9. Needs continuing reinforcement in work and teacher/student relationships

10. Negative attitude toward school

11. Oriented to concrete, tangible materials

12. Limited writing ability

13. Failure syndrome

B. The Teacher for Lab Classes

The teacher is instrumental in establishing an atmosphere conducive to learning and in using effective methods and materials. The following characteristics should be considered when selecting a teacher for the mathematics laboratory:

1. Trained and experienced in teaching

2. Patient, firm, and fair

3. Consistent in dealing with students

B. The Teacher for Lab Classes (Continued)

4. Interested in teaching mathematics laboratory students

5. Innovative and willing to seek and try new methods

6. Willing to make himself available to students for additional help and counseling.

Teaching math lab classes can be more demanding than teaching other math classes. No teacher should be assigned a total load of lab classes unless he requests it. It is necessary, however, that the teacher move to a mathematics laboratory setting for these classes.

Even the best teacher must have assistance to achieve the desired results. Cooperation between administrators and math lab teachers is essential. Many administrative decisions must be made. The making of these decisions, one way or the other, will have a direct bearing on the effectiveness of the program.

II. PERSONNEL AND THEIR DUTIES

A. Recommended Plan

The recommended personnel for operating a math lab program includes a master teacher, a regular math teacher, a teacher aide (paraprofessional), and student aides.

1. Master Teacher's Duties

a. To coordinate entire lab program

b. To evolve plan for year and make alterations as needed and to keep accurate records of results

c. To diagnose student deficiencies in mathematics

d. To recommend student movement from one group to another

e. To be responsible for own group testing and grading; assist in final grading of supervised study group

f. To introduce and develop various group activities such as slide rule, geo-board, calculator, probability, and flow-charting

g. To supervise and assist in individual student learning

II. PERSONNEL AND THEIR DUTIES (Continued)

1. Master Teacher's Duties (Continued)

h. To study student file folders from time to time and make recommendations for changes

i. To develop weekly plans for supervised study group along with teacher aide

j. To make weekly lesson plans, based on the yearly plan

k. To keep file folder on each student.

2. Regular Teacher's Duties

a. To assist master teacher in evolving a plan for the year and to keep accurate records of results

b. To assist in diagnosis of student deficiencies in mathematics

c. To recommend student movement from one group to another

d. To keep a weekly plan based on the yearly plan and to record activities completed each day

e. To be responsible for own group testing and grading; assist in final grading of supervised study group

f. To introduce and develop various group activities such as slide rule, calculator, geo-board, probability, and flow-charting

g. To supervise and assist in individual student learning

h. To keep a file folder on each student

i. To inject and help to carry out any ideas to improve the math lab program.

3. Teacher Aide's Duties

a. To be in charge of supervised study group

b. To help students work out problems and assist them in checking their work

c. To use audio-visual aids (e.g., filmstrips, sound films, and tapes) and to check out these aids

d. To record, each day, the activities completed from the weekly plan

e. To supervise testing and to score tests for supervised study group

II. PERSONNEL AND THEIR DUTIES (Continued)

3. Teacher Aide's Duties (Continued)

f. To assist students in reviewing various topics

g. To keep file folders up to date on supervised study group

h. To inject and carry out ideas to improve the math lab program.

4. Student Aide's Duties

At least one student aide (preferably two) per period should be assigned to each lab teacher. These students should be approved by the lab teacher with whom they will work. Duties are as follows:

a. To offer mathematical help to students if teacher is busy assisting another student

b. To distribute and collect materials as designated by the teacher

c. To assist in checking materials

d. To make up answer keys for tests and practice skills

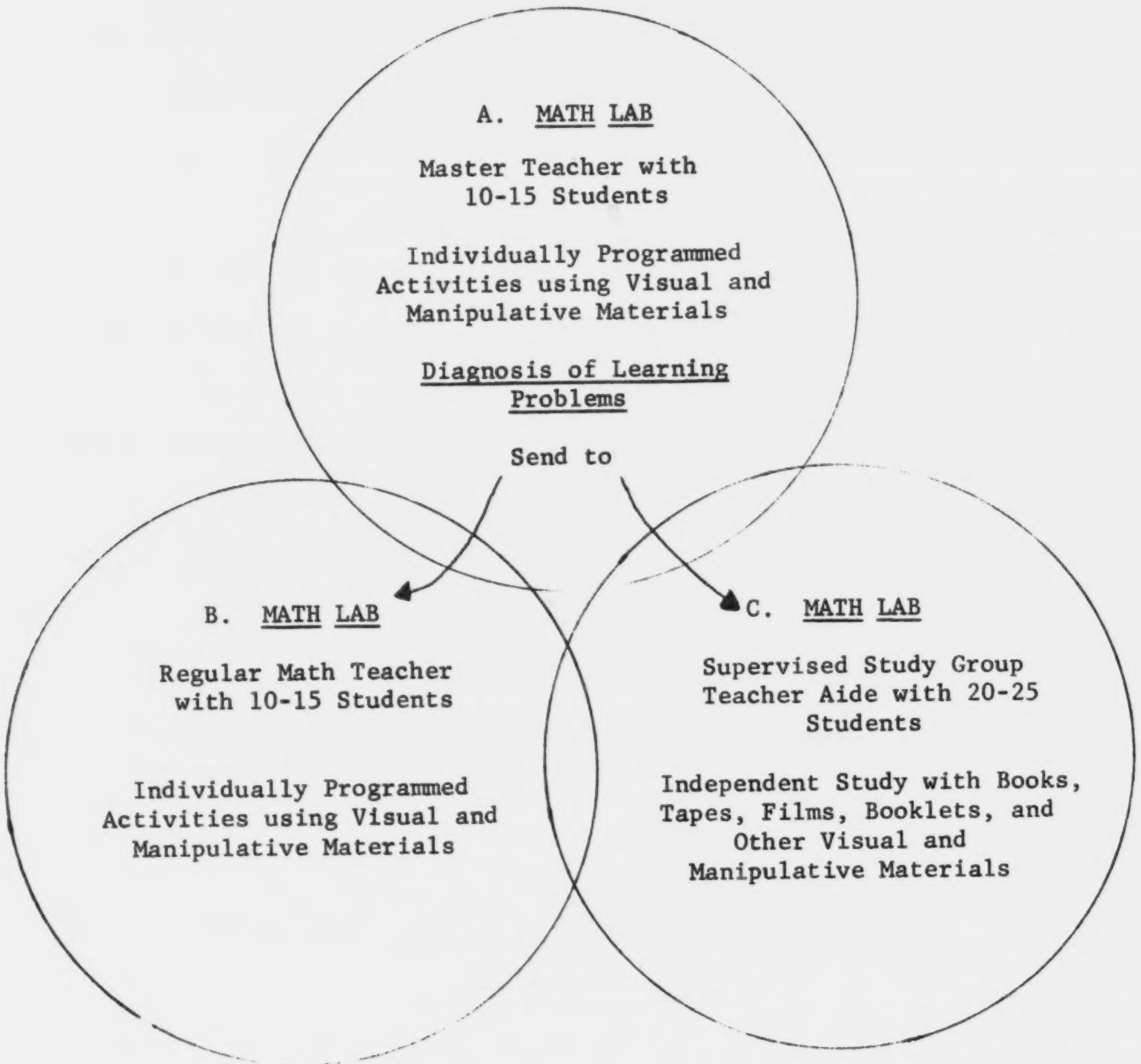
e. To keep progress files on all students up to date

f. To be on the teacher's roll and to set a good example to classroom students

g. To run errands as required

h. To assist in maintaining classroom order and cleanliness.

RECOMMENDED MATHEMATICS LABORATORY LAYOUT


A. MATH LAB
Master Teacher with 10-15 Students
Individually Programmed Activities using Visual and Manipulative Materials
Diagnosis of Learning Problems
Send to
B. MATH LAB
Regular Math Teacher with 10-15 Students
Individually Programmed Activities using Visual and Manipulative Materials
C. MATH LAB
Supervised Study Group Teacher Aide with 20-25 Students
Independent Study with Books, Tapes, Films, Booklets, and Other Visual and Manipulative Materials

NOTE: Students are rotated from room to room each six weeks or as needed.

II. PERSONNEL AND THEIR DUTIES (Continued)

B. Alternate Plan

Circumstances in a particular school may necessitate a modification of the recommended staffing for the math lab program. However, there should be a uniform plan for all labs at a given level, and it is considered advantageous to coordinate the entire lab program to facilitate student movement when needed.

Personnel in this case would include lab teachers and student aides. One or two classrooms (or more, depending on the number of students to be served) should be set up and adequately equipped for lab classes. The lab classroom contains many and varied materials as well as special furniture and equipment. This special classroom should be used for lab classes only, even though this might necessitate a teacher who does not teach lab classes all day moving to a different room for other classes.

If there is more than one lab teacher, one person should be designated as a resource person to coordinate the program and to assist others in the use of materials, manipulative devices, motivational topics, and procedures. This resource person or coordinator may be the department chairman or another lab teacher. The lab coordinator should be teaching or have recently taught lab classes.

The duties of the coordinator are as follows:

1. To evolve a master lab plan which would aid other lab teachers in developing specific plans
2. To select diagnostic and other tests
3. To request new materials and equipment as needed for the lab
4. To acquaint other math teachers with the lab approach
5. To attend seminars, workshops, and lectures and to inform other lab teachers of the proceedings

II. PERSONNEL AND THEIR DUTIES (Continued)

B. Alternate Plan (Continued)

The duties of the coordinator (Continued)

6. To assist other lab teachers in the use of materials, manipulative devices and laboratory procedures.

Other suggestions may be found listed under the duties of a master teacher, page 3.

The duties of the lab teacher are:

1. To diagnose student deficiencies in mathematics

2. To supervise and assist in individual student learning

3. To introduce and develop various group activities, such as slide rule, geo-board, calculator, probability, and flow-charting

4. To be responsible for testing and grading lab students; to keep accurate records on diagnostic and achievement testing and on student growth

5. To keep weekly lesson plans

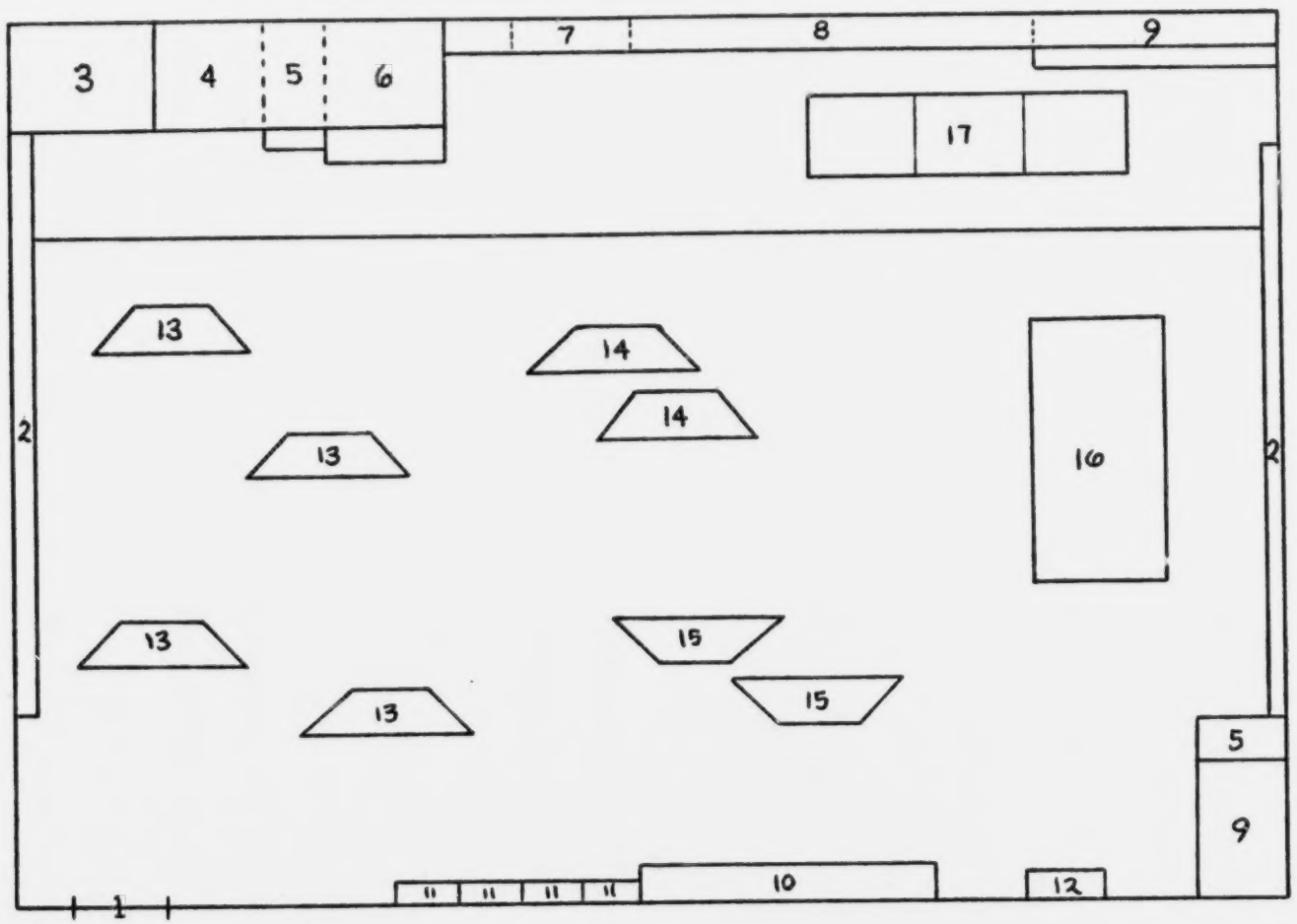
6. To keep a file folder on each student

7. To offer constructive criticism of the lab plan and to make suggestions on how to improve the lab to the coordinator.

See the list of duties for the regular teacher on page 4 for additional suggestions.

The student aide's duties are identical to those in Plan One; therefore, see page 5.

POSSIBLE PHYSICAL LAYOUT OF A LAB ROOM



KEY

1. Door
2. Windows
3. Closet
4. Shelves
5. File Cabinet
6. Teacher's Desk
7. Screen
8. Chalkboard
9. Bookshelves
10. Bookcase
11. Calculators
12. Typewriter
13. Trapezoid Tables
    Individual Work
14. Trapezoid Tables
    Use with Overhead
15. Trapezoid Tables
    Individual Film-
    strip Viewing
16. Table for Group Work
17. Carrels for Testing
    (or with Tape Recorder/
    Listening Set)

NOTE: The trapezoidal tables are changed daily to meet the needs of that day's activities. For example, on Friday (Game Day), these tables may be arranged for groups of two, three, or four.

III. PHYSICAL CHARACTERISTICS OF THE LAB

If a teacher does not teach lab classes every period, that teacher must move to a room which is properly equipped for lab classes. When more than one teacher uses the same lab room, it may be advisable to have duplicate sets of protractors, rulers, compasses, and flow-charting templates. Each teacher who uses the room should have a file cabinet. One file cabinet per room is not sufficient.

A. Number of Students

Class size should be reduced to a pupil-teacher ratio of less than 20 to 1. It is recommended that Phase I labs be limited to a maximum of 15 students per class.

B. Equipment and Furniture

Overhead projector

Projection stand

Corner mount screen

Calculators (at least 4)

Individual filmstrip viewers

Tape recorder and headsets

Filmstrip projector

Controlled reader

Math typewriter

Copy machine and transparency maker

Trapezoidal tables and chairs

Cafeteria-type table

File cabinet (one for each teacher who uses the room)

Wired carrels (enough for 8 students) and headsets

PHYSICAL CHARACTERISTICS OF THE LAB (Continued)

C. Instructional Materials

Foley booklets (all three sequences), preferably to be used as consumable materials

In-Depth materials to accompany Foley booklets

Supplementary textbooks (See Secondary Instructional Program of Brevard County Booklet)

Academic and Strategy Games

Classroom sets of protractors, compasses, rulers (English and Metric), meter sticks, and flow-charting templates

Classroom sets of geo-boards (minimum of 9 by 9 array; nails or pegs spaced 1 inch apart)

Classroom set of slide rules (must have CI scale) and Demonstration Slide Rule

Transparencies (blank rolls or sheets as well as prepared transparencies or printed originals)

Filmstrips

Tapes (prepared drill tapes and blank tapes)

Models

Rubber stamps (grids, business forms, banking)

Boxed or programmed materials such as SRA Computational Skills Kit or Lessons for Self-Instruction

(See "Recommendations for Equipping a Secondary Math Lab Classroom: Low Phases" at the end of this manual for vendors, approximate prices, and specific games.)

IV. TESTING PROGRAMS

A. Placement

There are many available placement tests; however, such tests should be selected on the basis of their design to point out individual mathematical deficiencies or mathematical grade level. The following are recommended:

1. CTBS (Phase I and II) Comprehensive Test of Basic Skills - Arithmetic - Computation, Concepts, and Applications (Q-3). This test shows areas of deficiency. It may be used at the beginning of the year and again at the end of the year to show overall growth.

2. Algebra Prognosis (recommended for Phase II) - Orleans-Hanna - (Available from Harcourt, Brace & World, Inc.). This test may be used to test readiness to take algebra.

3. L.S.I. - (Lessons for Self-Instruction.) - Locator Test from California Test Bureau. These tests give the mathematics grade level of the student.

4. Stanford Achievement Test - These scores are the basis for county phase predictions.

5. SRA Survey Test - This two-part test covers computation with whole numbers, fractions, decimals, and per cent. The missed items indicate which specific diagnostic test the student should take.

The Continuum Profile Sheet from elementary school may also be helpful in 7th year student placement.

B. Diagnosis

Diagnostic Testing is an absolute "must". Each test should be designed to diagnose the student's strengths and weaknesses on a specific topic or skill.

1. Pre-Tests (accompanying Foley booklets). Before beginning work on a mainstream topic, the student takes a pre-test for that topic. Depending upon the results, he can then do one of two things:

   a. If his score is high, and his understanding of the various areas is uniformly good, he should bypass the mainstream booklet and work in the related in-depth activities

IV. TESTING PROGRAMS (Continued)

B. Diagnosis (Continued)

1. a. (Continued)

For example: Suppose a student takes the Pre-Test for WHOLE NUMBERS and the results indicate that he understands the following concepts: place value, addition, subtraction, multiplication, and division of whole numbers, finding missing values in equations, such as 9 x b = 54, and simple inequalities where there is no missing value. He should then begin work immediately on the In-Depth Topics related to WHOLE NUMBERS.

Note: Another option for a student in this category is to work in a related book in the second sequence - Patterns and Discovery.

b. If, as is more likely, the Pre-Test or teacher observation indicates that the student is deficient in any area, he should be directed to the mainstream booklet. He can work independently or with a small group; and he can cover the entire booklet or just those parts in which he shows deficiencies. If, for example, a student shows little understanding of any concept on the Pre-Test for WHOLE NUMBERS, he should work through the entire mainstream booklet. If, however, he only shows deficiencies in his division of whole numbers and finding missing values in equations, he need only work on the pages in the mainstream booklet related to these concepts. In practice, the Pre-Test should indicate quite clearly which of these two options is preferable for the student. If there is any doubt, the student can begin work on the mainstream booklet. Then, if

IV. TESTING PROGRAMS (Continued)

B. Diagnosis (Continued)

1. b. (Continued)

the teacher sees that this work is too easy for him, he can be channeled into the in-depth topics. (See next page for diagram).

2. SRA Diagnostic Tests (Science Research Associates) - These 16 tests on specific topics may be used to determine computational weaknesses.

3. Teacher-made Tests.

C. Achievement

The Achievement Tests are the only measurable criteria in written form for determining growth and progress for later evaluation purposes.

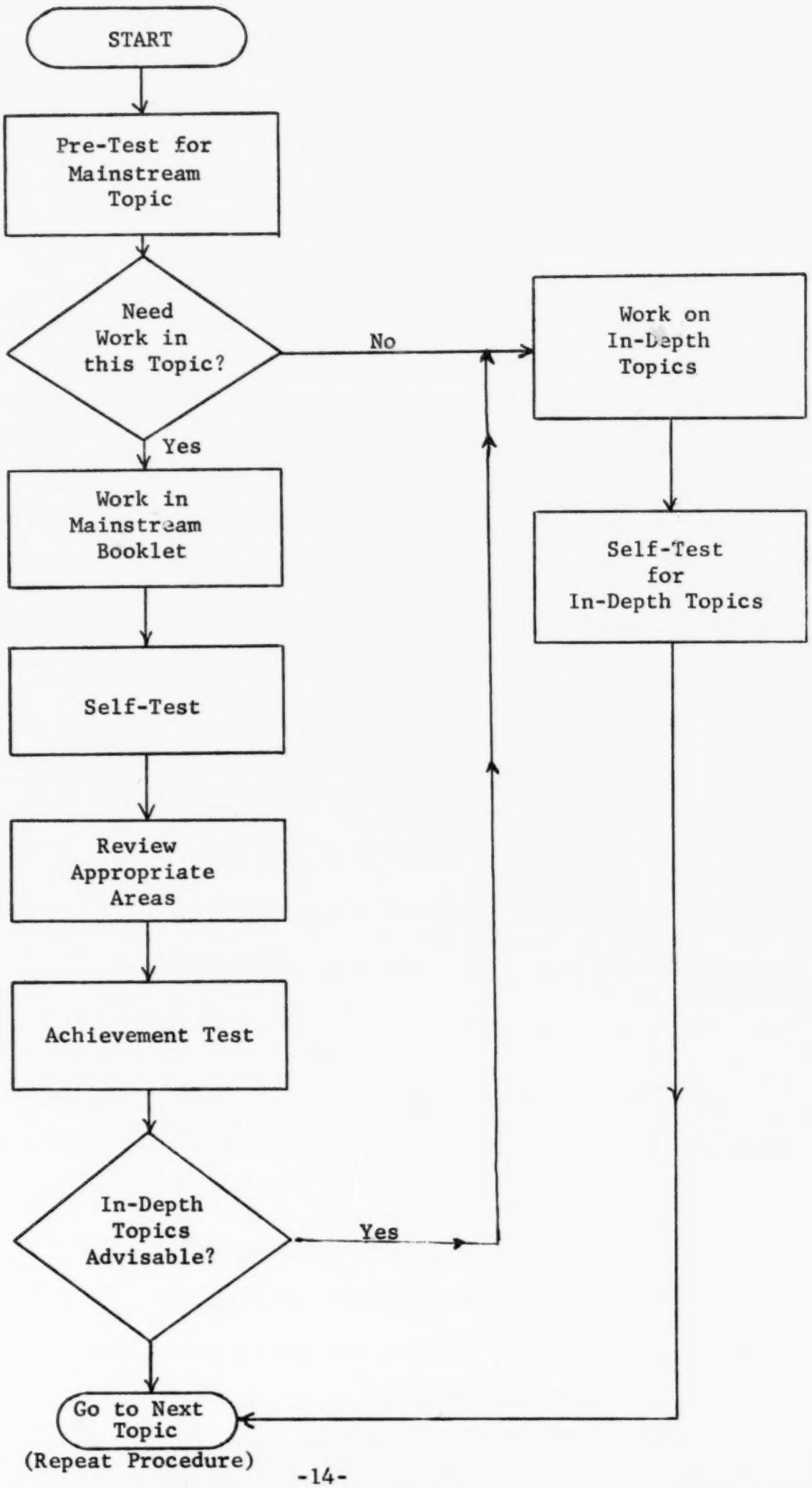
1. Foley materials: When the student completes work in an assigned booklet, he takes the Self-Test at the end of the booklet. He then reviews and corrects each item missed on the Self-Test. The student should be allowed to aid in correcting his own Self-Test. The next step, a teacher-administered and teacher-corrected Achievement Test on the same material, should encourage conscientiousness in this self-evaluation.

If the teacher feels the student will benefit from further study of the same topic, the student can work on the related in-depth cards. Otherwise, the student repeats the procedure described above for each mainstream topic in the sequence.

The student who works in the in-depth topics takes a Self-Test for each in-depth card completed before moving on to the next card or booklet.

2. SRA Progress Tests: When the student completes an exercise card from the SRA Kit, he takes the Progress Test on that skill area to determine his improvement.

3. Teacher-made Tests.


START
Pre-Test for Mainstream Topic
Need Work in this Topic?
No
Yes
Work on In-Depth Topics
Work in Mainstream Booklet
Self-Test for In-Depth Topics
Self-Test
Review Appropriate Areas
Achievement Test
In-Depth Topics Advisable?
Yes
Go to Next Topic
(Repeat Procedure)

V. EVALUATION PROCEDURE

Student evaluation should be built on a continuous diagnosis of each student's needs and deficiencies and a constant appraisal of his growth. The emphasis should be on each student's progress relative to his own past performance rather than to the performance of the class as a whole.

Evaluation should be relative to the individual, and factors such as attitude, interest, and effort should be considered in this individual evaluation. Teachers must also constantly evaluate their own efforts and modify their strategies according to the needs of each individual learner.

Evaluation should include all of the relevant criteria, and not be based solely on the results of achievement tests. Approximately one-third of each student's grade should be based on absolute achievement (achievement and/or diagnostic tests or pre-tests), one-third on observable behavior (attendance, tardiness, effort, pencil and paper, seeks help when needed), and one-third on growth quotient:

$$\text{i.e., Growth Quotient} = \frac{\text{Achievement Test Score minus Pre-Test Score (Diagnostic Test)}}{\text{100 minus Pre-Test Score}}$$

The growth percentage is attained by comparing actual growth to possible growth. For example, a student who scores 40% on the Pre-Test and 80% on the Achievement Test would have a growth quotient of approximately 67%:

$$G.Q. = \frac{80 - 40}{100 - 40} = \frac{40}{60} \approx 67\%$$

Quality of performance grades may be based either on an A, B, C, D, F scale, or a corresponding S, N, U scale (A = S+, B = S, C = S-, D = N, F = U)

VI. RECORD KEEPING

Accurate records are essential for evaluating the lab program as well as determining student progress. A few suggested sample forms follow.

VI. RECORD KEEPING (Continued)

A. Sample Attendance Card (5 x 8 index card)

JOHN DOE	GRADE 11	STANFORD ACH. SCORE 20	1st Per.
Absent or Tardy			Attitude and Comments
1st 6 Weeks 9/15 - A 9/16 - T			1st 6 Weeks
2nd 6 Weeks			2nd 6 Weeks

Since students may be exchanged from area to area and from teacher to teacher, use of a regular roll-book is not feasible. Attendance cards may move with the students from one teacher to another.

B. All-Purpose Record Sheets

A mimeographed form (marked off as in samples) may be used for many purposes, as illustrated in the following examples:

1. Class Profile Sheet: Tells at a glance each student's performance.

CLASS PROFILE SHEET 1st Per. 4th 6 Wks.	Fraction Book	Sets	Geo-Board	Slide Rule	Number Theory	Deci-mals					Flash Cards	Flash Cards	
1. Allen, Joe (Pre-Test / Achiev. Test)											93 / 95	82 / 88	
2. Baker, Jack					65 / 94								
3. Cook, Sally	39 / 85												
4.													

VI. RECORD KEEPING (Continued)

B. <u>All-Purpose Record Sheets</u> (Continued)

2. Key Check-out Sheet: Insures the return of all answer keys and indicates the whereabouts of them.

KEY CHECK OUT (Foley Booklet Keys)		Fraction Book	Sets	Whole Numbers	Deci-mals									
1.	Doe, John Out / In													
2.	Dunn, Mary		✓											
3.	Foreman, Mabel				✓ ✓									
4.														
5.														
6.														

3. General Check-out Sheet

CHECK-OUT SHEET (General)		Winning Touch	Quizmo Mul.&Div.	Mono-poly	Twixt	Pencil	Rest Room	Rulers	Slide Rule	Compass	Pro-tractor			
1. Doe, Jim	Out / In						9:10 / 9:20							
2. Johnson, Jack			✓ ✓											
3. Jones, Sarah				✓										
4. Roberts, Bob								#6 ✓						
5. Riddle, Nell									#4 ✓					
6.														

It is suggested that rulers, protractors, compasses, slide rules and other items checked out to students be numbered. Some teachers prefer to have students use materials with a number that corresponds to their assigned class numbers. (Hint: A good number marking substance is red finger nail polish.)

Note: See following pages for individual record keeping charts.

STUDENT PROFILE CHART

NAME Doe, John CLASS Second Period

TOPICS	% CORRECT ON PRE-TEST (1)	% CORRECT ON ACHIEVEMENT TEST (2)	GROWTH QUOTIENT
PROBABILITY	NO PRE-TEST ON THESE		
GEO-BOARD I			
SLIDE RULE whole numbers			
FLOW CHART I		80	
WHOLE NUMBERS operations and relations	40	80	67%
SETS members and subsets			
FRACTIONS multiplication and division			
FRACTIONS addition and subtraction			
ANGLES measurement and measures			
NUMBER patterns - theory			
METRIC GEOMETRY linear, area, and volume measure			
DECIMALS meanings and operations			

STUDENT ENRICHMENT CHART

NAME Doe, John CLASS Second Period

Enrichment Topics (In-Depth Cards)	% Correct on Test for Topic 1	% Correct on Test for Topic 2	% Correct on Test for Topic 3	% Correct on Test for Topic 4
WHOLE NUMBERS operations and relations				
SETS members and subsets				
FRACTIONS addition and subtraction	70	65	80	80
FRACTIONS multiplication and division				
ANGLES measurement and measures				
METRIC GEOMETRY linear, area, and volume measure				
NUMBER patterns - theory				
DECIMALS meanings and operations				

VI. RECORD KEEPING (Continued)

A central file could be established with a manila folder for each student. These folders may contain individual profile charts, pre-tests, achievement tests, report cards, and other student work or records deemed necessary by the teacher.

VII. TYPES OF INSTRUCTION

A. Total Group Instruction

Experience has shown that total group instruction with this type student has very limited value. The most effective teaching method with these students is one which is highly individualized.

Total group instruction may be beneficial in introducing enrichment topics (e.g., calculator activities, geo-board, slide rule, flow-charting, and probability). Because of the short attention span of the majority of these students, total group presentation should be limited to a maximum of ten minutes.

B. Individualized Instruction

The mathematical deficiencies and learning speeds of reluctant learners vary widely. The teacher must continually find out how much each student has already learned, and how much he still needs to learn. Each student should be allowed to learn in his own way, with materials appropriate to his own needs, at his own pace, and be evaluated against his own performance.

A series of short units, each of which concentrates on one specific topic and requires a minimum of reading, best satisfies the above requirements. Frequent diagnosis and evaluation allow a student to know immediately the results of his efforts.

The reluctant learner has often experienced failure with the traditional textbook oriented program. A series of short units helps the student feel that he can absorb and finish the material.

VII. TYPES OF INSTRUCTION (Continued)

B. Individualized Instruction (Continued)

Foley materials will be used in the secondary mathematics laboratory program. The following is a suggested student procedure for use of the Skills and Patterns booklets: (This procedure would be appropriate for any booklet type program.)

1. Complete three pages, then get key from aide or teacher, check and correct those problems missed.

2. Complete three more pages and repeat the above procedure. Do this until reaching the Self Test at end of each booklet.

3. Do Self Test and correct it yourself (get key from aide or teacher).

4. Next take Achievement Test on completed booklet. This is then scored by the teacher or teacher aide.

5. Achievement Test score should be at least 75% or show a 30% growth quotient to go to the next booklet. Check with teacher on which Pre-Test to take next.

6. Take Pre-Test on next booklet to see if you should complete the next booklet or work on In-Depth materials.

7. It is desirable for the student to check his own Pre-Test; however, the teacher may wish to score it. If the score is above 75%, the student may then take the Achievement Test on that booklet.

C. Small Group Instruction

These students should be encouraged to work together in groups of two or more or to give assistance to each other. At times, student-student communication is more effective than teacher-student communication. Furthermore, students enjoy working in pairs which provides a mutually profitable working arrangement. They may also participate effectively in self-evaluation. This helps students to accept more responsibility for their learning and at the same time makes the learning process more meaningful for them. The Skills and Patterns booklets have many scrimmage activities geared for small-group participation.

VII. TYPES OF INSTRUCTION (Continued)

D. In-Depth Cards

There are four related in-depth cards for each Skills and Patterns booklet. After completing a booklet, the student may need or desire further work on that topic. He may then choose a related in-depth card, which contains expository material, activities, answers for the activities, and a Self-Test. These cards are designed to help bridge the gap between a "basic" and a regular course.

VIII. INITIAL ORGANIZATION

A. Discipline

Good discipline does not mean the same thing to every teacher. The lab atmosphere must entail a certain amount of conversation and movement by the students; in other words, effective discipline does not mean absolute quiet. It is important to be firm but to be consistent and fair.

The effectiveness of discipline in a classroom may be measured by the extent of involvement by the students. The talking and other activity which is normal among students in lab classes is a small price to pay for a high interest level.

It is necessary for these students to know what is expected of them. The teacher might make a ditto list of classroom rules relating to restroom privileges, gum chewing, moving around the room, use of materials and equipment, tardiness, leaving the room, seating arrangement, noise level, sleeping in class, etc.

B. Initial Three Weeks Lesson Plan

The following is a recommended plan for the math lab program beginning with the first week and working toward a typical week:

VIII. INITIAL ORGANIZATION (Continued)

B. Initial Three Weeks Lesson Plan (Continued)

1. First Week

a. Monday - Orientation Day - Explanation of the lab approach and reason for it - Ground Rules - (expected discipline) - Explanation of materials to be covered: Foley booklets, games, grading system. Allow time to examine the booklets. Wind up the period by beginning Probability Booklet.

b. Tuesday - Begin Placement Testing: If the student has had no algebra, he should take the CTBS; if he has had pre-algebra, take Algebra Prognosis; if he has had algebra, even if he failed it, then take the Anderson Algebra Test.

c. Wednesday - Complete the above testing. If time remains begin actual work on Probability Booklet.

d. Thursday - All students take the Pre-Test on Whole Numbers. Finish the period by working in the Probability Booklet.

e. Friday - Mathematical Skills and Strategy Games - Explain and talk about all the games and assign games to individuals. Participation should be required.

2. Second Week

a. Monday - Begin work in appropriate mainstream booklet chosen from results of placement tests and Whole Number Pre-Test. (Probably, Whole Number Booklet or Set Booklet - See page 3 of A Teaching Strategy for Skills and Patterns for suggested order of topics.)

b. Tuesday - Work in the Probability Booklet.

c. Wednesday - Do Cross Number Puzzles (See Cross Number Puzzles from J. Weston Walch, Publisher - Suggest use of puzzles in sequence) or Magic Squares or Math Maze or Math

VIII. INITIAL ORGANIZATION (Continued)

B. Initial Three Weeks Lesson Plan (Continued)

2. Second Week (Continued)

c. Wednesday (Continued)

Pictographs. (Have two puzzles or one puzzle and another activity available).

d. Thursday - Resume work in Whole Number or Set Booklet.

e. Friday - Mathematical Skill and Strategy Games (Let students choose game in which he wishes to participate, but participation is a must.)

3. Third Week (Typical Week)

a. Monday - Work in Mainstream Booklet (Whole Number or Set Booklet) for one-half of the class time. Then, begin flash card testing (Use Modern Math Flash Cards) and Calculator Activities.

b. Tuesday - Reverse the activities listed for Monday.

c. Wednesday - Work in the mainstream booklet for the entire period.

d. Thursday - Spend one-half period on the Probability Booklet and the other half on Cross Number Puzzles.

e. Friday - Mathematical Skills and Strategy Games - Student will choose the game or games in which he wishes to participate.

See List of Games in back of the manual for suggestions. For example, Twixt is a strategy game; Winning Touch stresses multiplication facts; Quizmo (2 types) involves all four operations.

IX. DESCRIPTION OF THE PROGRAM

For an overview of the topics covered in the Skills and Patterns booklets see pages 4-12, in A Teaching Strategy.

Regardless of the materials used in a lab program, the following skills should be emphasized:

A. WHOLE NUMBERS

1. Addition

a. The student should be able to write numbers in expanded form.

(1) Write in expanded notation:

47 = 4 x 10 + 7 x 1

236 = 2 x 100 + 3 x 10 + 6 x 1

(2) Fill in the missing values:

62 = 6 tens + 2 ones

46 = 30 tens + 16 ones

563 = 4 hundreds + 15 tens + 13 ones

416 = 6 ones + 3 hundreds + 11 tens

b. The student should be able to add two-two digit numbers; two-three digit numbers; three-three digit numbers in both vertical and horizontal form.

(1) Add each of the following:

$$\begin{array}{r} 42 \\ +34 \\ \hline 76 \end{array} \qquad \begin{array}{r} 793 \\ 201 \\ +519 \\ \hline 1513 \end{array}$$

79 + 44 = 123

581 + 249 = 830

c. The student should be able to supply the missing addends in problems:

7 + 9 = 16

9 + a = 27

a = 18

d. The student should be able to place relations symbols (>, <, =) between two addition expressions to show their relationship.

5 + 4 [=] 4 + 5

9 + 3 [>] 7 + 4

IX. DESCRIPTION OF THE PROGRAM (Continued)

A. WHOLE NUMBERS (Continued)

2. Subtraction

a. The student should be able to find the difference in expanded form (regrouping).

62 = 6 tens + 2 ones = 5 tens + 12 ones

-37 = 3 tens + 7 ones = 3 tens + 7 ones

2 tens + 5 ones = 25

b. The student should be able to subtract a two digit number from another two digit number.

$$\begin{array}{r} 38 \\ -12 \\ \hline 26 \end{array} \qquad \begin{array}{r} 62 \\ -46 \\ \hline 16 \end{array}$$

c. The student should be able to subtract a three digit number from another three digit number.

$$\begin{array}{r} 653 \\ -165 \\ \hline 488 \end{array} \qquad \begin{array}{r} 251 \\ -189 \\ \hline 62 \end{array}$$

d. The student should be able to supply the missing term in a given subtraction sentence.

41 - 19 = 22 $\qquad$ a - 15 = 30

a = 45

e. Given an addition fact the student should be able to write two related subtraction facts.

5 + 2 = 7 $\therefore$ 7 - 2 = 5, or 7 - 5 = 2.

3. Multiplication

a. The student should know his multiplication facts of numbers 0 - 9.

0 x 2 = 0 $\qquad$ 3 x 8 = 24 $\qquad$ 4 x 5 = 20

7 x 9 = 63 $\qquad$ 6 x 3 = 18

IX. DESCRIPTION OF THE PROGRAM (Continued)

A. WHOLE NUMBERS (Continued)

3. Multiplication (Continued)

b. The student should be able to multiply a two digit number by another two digit number.

$$\begin{array}{r} 38 \\ \times\ 34 \\ \hline 1292 \end{array} \qquad\qquad \begin{array}{r} 12 \\ \times\ 15 \\ \hline 180 \end{array}$$

c. The student should be able to multiply a three digit number by a two digit number.

$$\begin{array}{r} 621 \\ \times\ 72 \\ \hline 44{,}712 \end{array} \qquad\qquad \begin{array}{r} 467 \\ \times\ 19 \\ \hline 8873 \end{array}$$

d. The student should be able to multiply a three digit number by another three digit number.

$$\begin{array}{r} 971 \\ \times\ 468 \\ \hline 454{,}428 \end{array} \qquad\qquad \begin{array}{r} 534 \\ \times\ 102 \\ \hline 54{,}468 \end{array}$$

e. The student should be able to multiply a given number by 10, 100, or 1000.

86 x 100 = 8600

93 x 10 = 930

21 x 1000 = 21000

f. The student should be able to fill in the missing values in a given multiplication sentence.

8 x 7 = 56 $\qquad\qquad$ 4 x a = 36

a = 9

g. The student should be able to fill in the relation that will make each given sentence true. (=, $>$, $<$)

6 x 4 [=] 2 x 12 $\qquad$ 8 x 5 [$<$] 9 x 6

IX. DESCRIPTION OF THE PROGRAM (Continued)

A. WHOLE NUMBERS (Continued)

3. Multiplication (Continued)

h. The student should be able to use the distributive properties in given multiplication problems.

$3 \times (6 + 1) = (3 \times 6) + (3 \times 1) = \underline{18} + \underline{3} = \underline{21}$

$(2 + 3) \times 5 = \underline{2 \times 5} + \underline{3 \times 5} = \underline{10} + \underline{15} = \underline{25}$

4. Division

a. The student should be able to recognize and rewrite division as the inverse of multiplication.

$7 \times 3 = 21 \quad \therefore \quad \frac{21}{3} = \underline{7}$

b. The student should be able to write and solve division problems with one, two, or three digit numbers in four different ways.

$4/\overline{12} = \underline{3} \qquad \frac{12}{4} = \underline{3} \qquad 12 \div 4 = \underline{3} \qquad 4 \times \underline{3} = 12$

c. The student should be able to divide a two digit number by a one digit number.

$7/\overline{49} = \boxed{7} \qquad 9/\overline{72} = \boxed{8}$

d. The student should be able to divide a three digit number by a two digit number.

$21/\overline{609} = \boxed{29} \qquad 33/\overline{396} = \boxed{12}$

e. The student should be able to divide a four digit number by a two digit number.

$39/\overline{4095} = \boxed{105}$

f. The student should be able to solve division problems involving zero in the quotient or as the dividend.

$5/\overline{0} = \boxed{0} \qquad 11/\overline{110011} = \boxed{10001}$

IX. DESCRIPTION OF THE PROGRAM (Continued)

A. WHOLE NUMBERS (Continued)

4. Division (Continued)

g. Given a multiplication fact, the student should be able to write two related division facts.

$7 \times 5 = 35 \quad \therefore \quad 35 \div 5 = \underline{7}$ or $\frac{35}{7} = \underline{5}$

h. The student should be able to fill in the missing values in a given division problem.

$\underline{42} \div 7 = 6$ $\qquad$ $\frac{21}{7} = a$, $a = \underline{3}$

i. The student should be able to fill in the relation that will make a given sentence true.

$(3 \times 4) \div 2 = \boxed{6}$ $\qquad$ $(12 \times 4) \div 6 = \boxed{8}$

j. The student should be able to predict the number of digits in a quotient. (Attempt to divide the divisor into the first number of the dividend; if this works, then count the number of digits in the dividend and the quotient will have the same number of digits. For example,

$\frac{650}{5}$ Five will go into six, so there are

Answer: 3 digits. three digits in the quotient.

If you desire additional help, refer to Slide Rule Booklet, from Skills and Patterns, page 20. If the divisor will not divide into the first digit of the dividend, then move one digit to the right until the divisor will divide into the first group of digits in the dividend and the answer will be one plus the number of digits following.)

a. $\frac{651}{7}$ Seven will not go into 6, but will go into 65. There is one digit after the 5; therefore, 1 + 1 = 2 digits in the quotient.

Answer: 2 digits

IX. DESCRIPTION OF THE PROGRAM (Continued)

A. WHOLE NUMBERS (Continued)

4. Division (Continued)

j. (Continued)

b. $\frac{6510}{70}$

Answer: 2 digits.

Seventy will not go into 6, it will not go into 65, but will go into 651. The number of digits after 1 is one; therefore, the answer has 1 + 1 or 2 digits in the quotient.

B. SETS

1. The student should be able to determine the cardinal number (cardinality) of a set.

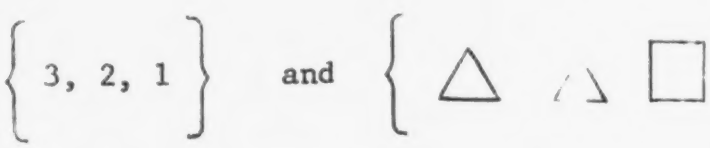
Give the number property of each set:

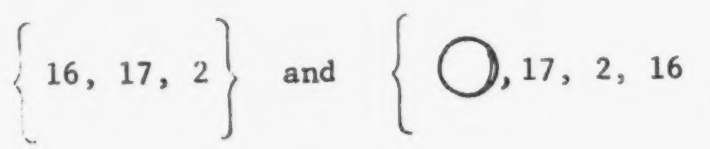
X = { } n(X) = 3

Y = { Whole numbers between 3 and 8 } n(Y) = 4

2. The student should be able to identify equivalent sets.

Write true if the pair of sets are equivalent; false, if they are not.

a. { 3, 2, 1 } and {  } True

b. { 16, 17, 2 } and {  } False

c. { 9, 8, 6, 7 } and { 6, 7, 8, 9 } True

IX. DESCRIPTION OF THE PROGRAM (Continued)

B. SETS (Continued)

3. The student should be able to distinguish between equal and equivalent sets.

One of the pairs of sets in Problem 2 is an equal set. Circle the correct answer.

a) b) (c)

4. The student should be able to perform the two basic set operations of union and intersection.

$X = \{b, e, f\}$ $Y = \{1, 4, e\}$

a. $X \cup Y = \{b, e, f, 1, 4\}$

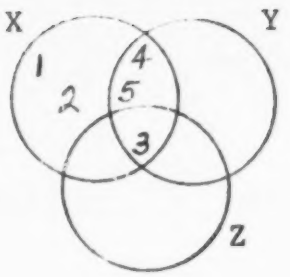
b. $X \cap Y = \{e\}$

5. The student should be able to perform the two basic set operations ($\cup$, $\cap$) using Venn diagrams.

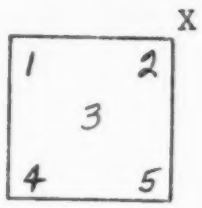
Given: $X = \{1, 2, 3, 4, 5\}$

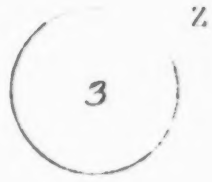
$Y = \{3, 4, 5\}$

$Z = \{3\}$



or





$X \cup Y = \{1, 2, 3, 4, 5\}$

$X \cap Y = \{3, 4, 5\}$

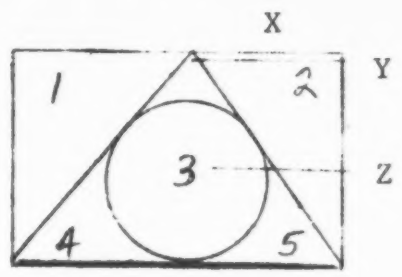
$X \cup Z = \{1, 2, 3, 4, 5\}$

$X \cap Z = \{3\}$

$Y \cup Z = \{3, 4, 5\}$

$Y \cap Z = \{3\}$

$X \cap Y \cap Z = \{3\}$



IX. DESCRIPTION OF THE PROGRAM (Continued)

B. SETS (Continued)

6. The student should be able to determine the number of subsets which can be formed from a given set.

a. Given:

$$A = \{1, 2\}$$

Subsets:

$$\{1, 2\} \ , \ \{1\} \ , \ \{2\} \ , \ \{\}$$

Number of subsets = 4 .

7. The student should be able to locate ordered pairs on a graph using positive integers and to name points on a graph as ordered pairs. (Geo-board activities may be used to reinforce this.)

a. Locate the set of ordered pairs on the graph.

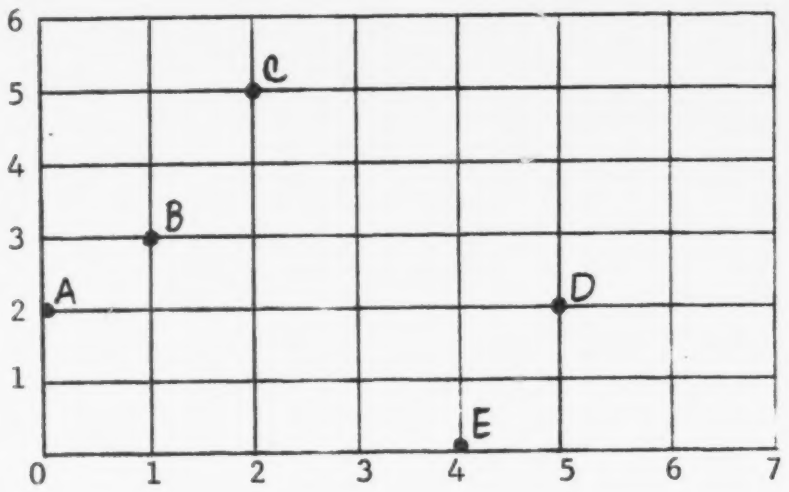
A = (0, 2)

B = (1, 3)

C = (2, 5)

D = (5, 2)

E = (4, 0)



b. List the set of ordered pairs indicated.

A = (2, 2)

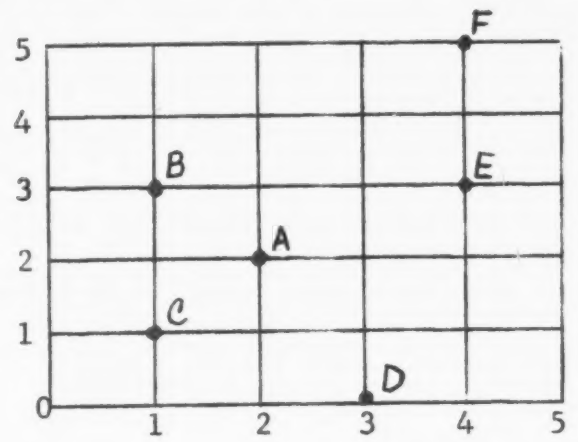
B = (1, 3)

C = (1, 1)

D = (3, 0)

E = (4, 3)

F = (4, 5)



IX. DESCRIPTION OF THE PROGRAM (Continued)

C. FRACTIONS

1. Addition

a. The student will be able to change a fraction to an equivalent fraction, with a different denominator.

(1) $\frac{12}{18} = \frac{\boxed{2}}{3}$

(2) $\frac{2}{5} = \left\{ \frac{2}{5}, \frac{4}{10}, \frac{6}{\boxed{15}}, \frac{\boxed{8}}{20}, \frac{\boxed{10}}{\boxed{25}} \right\}$

b. The student will be able to place $>$, $<$ or $=$ between two single fractions to show relationship.

(1) $\frac{2}{3} \boxed{=} \frac{8}{12}$ (2) $\frac{4}{7} \boxed{<} \frac{8}{13}$

c. The student will be able to add two or more fractions or mixed numbers with like denominators and reduce sum to lowest terms.

(1) $\frac{2}{7} + \frac{3}{7} = \underline{\frac{5}{7}}$.

(2) $9\frac{5}{6} + 1\frac{5}{6} = 10\frac{10}{6} = 11\frac{4}{6} = \underline{11\frac{2}{3}}$.

d The student will be able to add two or more fractions or mixed numbers with unlike denominators and express the sum in lowest terms.

(1) $\frac{2}{3} + \frac{1}{6} + \frac{3}{4} = \frac{8}{12} + \frac{2}{12} + \frac{9}{12} = \frac{19}{12} = \underline{1\frac{7}{12}}$.

(2) $9\frac{2}{3} + 1\frac{5}{6} = 9\frac{4}{6} + 1\frac{5}{6} = 10\frac{9}{6} = 11\frac{3}{6} = \underline{11\frac{1}{2}}$.

2. Subtraction

a. The student will be able to subtract fractions with like or unlike denominators and reduce answer to lowest terms.

(1) $\frac{5}{6} - \frac{1}{6} = \frac{4}{6} = \underline{\frac{2}{3}}$.

IX. DESCRIPTION OF THE PROGRAM (Continued)

C. FRACTIONS (Continued)

2. Subtraction (Continued)

a. (2) $\frac{5}{6} - \frac{1}{2} = \frac{5}{6} - \frac{3}{6} = \frac{2}{6} = \underline{\frac{1}{3}}$.

b. The student will be able to subtract fractions or mixed numbers from whole numbers or mixed numbers.

(1) $2\frac{2}{3} = 2\frac{4}{6}$

$-1\frac{1}{2} = 1\frac{3}{6}$

$\boxed{1\frac{1}{6}}$

(2) $7 - 3\frac{3}{8} = 6\frac{8}{8} - 3\frac{3}{8} = \boxed{3\frac{5}{8}}$

(3) $7\frac{2}{7} - 1\frac{1}{2} = 7\frac{4}{14} - 1\frac{7}{14} =$

$6\frac{18}{14} - 1\frac{7}{14} = \boxed{5\frac{11}{14}}$

3. Multiplication

a. The student should be able to multiply two common fractions or a whole number by a fraction and reduce to lowest terms.

(1) $\frac{2}{3} \times \frac{3}{6} = \frac{6}{18} = \boxed{\frac{1}{3}}$ (2) $6 \times \frac{1}{8} = \frac{6}{8} = \boxed{\frac{3}{4}}$

b. The student should be able to perform more complex multiplication including improper fractions and mixed numbers.

(1) $\frac{6}{2} \times \frac{2}{6} = \frac{12}{12} = \boxed{1}$

(2) $2\frac{1}{2} \times 3\frac{2}{5} = \frac{5}{2} \times \frac{17}{5} = \frac{85}{10} = 8\frac{5}{10} = \boxed{8\frac{1}{2}}$

IX. DESCRIPTION OF THE PROGRAM (Continued)

C. FRACTIONS (Continued

4. Division

a. The student should be able to divide simple and improper fractions and mixed numbers by using reciprocols.

(1) $\frac{3}{4} \div \frac{1}{2} = \frac{3}{4} \times \frac{2}{1} = \frac{6}{4} = \frac{3}{2} = \boxed{1\frac{1}{2}}$

(2) $3\frac{1}{4} \div 2\frac{1}{2} = \frac{13}{4} \div \frac{5}{2} =$

$\frac{13}{4} \times \frac{2}{5} = \frac{26}{20} = \frac{13}{10} = \boxed{1\frac{3}{10}}$

D. DECIMALS

1. Place Value

a. A student should be able to write decimals in expanded notation. He should be able to do this, using words, fractions, or decimals.

(1) 9.5 = 9 ones + 5 tenths

(2) 15.25 = 10 + 5 + $\frac{2}{10}$ + $\frac{5}{100}$

(3) 4.25 = 4 + .2 + .05

b. The student should also be able to read a decimal numeral, or to write a word statement as a decimal correct to millionths.

(1) 24.31 = twenty-four and thirty-one hundredths

(2) two hundred and two thousandths = 200.002

2. Addition

a. A student should be able to add two or more numbers with whole number parts and decimals to the millionths.

(1)
```
 73.678421
+1.321579
----------
 75.000000
```

(2) 75 + 2.3 + 10.06 = 87.36

IX. DESCRIPTION OF THE PROGRAM (Continued)

D. DECIMALS (Continued)

3. Subtraction

a. A student should be able to subtract a decimal number from a whole number or from another decimal number.

(1) $\begin{array}{r} 64 \\ -31.17 \\ \hline 32.83 \end{array}$

(2) $75.07 - 25.99 = \boxed{49.08}$

4. Multiplication

a. A student should be able to multiply a decimal number by a whole number or another decimal number and place the decimal correctly in the product.

(1) $\begin{array}{r} .25 \\ \times\ 4 \\ \hline 1.00 \end{array}$

(2) $\begin{array}{r} .25 \\ \times\ .04 \\ \hline .0100 \end{array}$

5. Division

a. The student should be able to divide a decimal by a whole number or by another decimal and place decimal correctly in the quotient.

(1) $3\overline{)1.50}$ quotient $.50$

(2) $3.5\overline{)1.40}$ quotient $.4$

6. Change Decimals to Fraction Forms

a. The student should be able to change a decimal to a fraction and a fraction to a decimal.

(1) $.25 = \frac{25}{100} = \boxed{\frac{1}{4}}$

(2) $\frac{3}{4} = 4\overline{)3.00}$ quotient $.75$

$\begin{array}{r} 28 \\ \hline 20 \\ 20 \\ \hline \end{array}$

IX. DESCRIPTION OF THE PROGRAM (Continued)

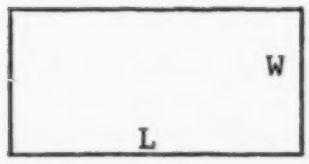
E. GEOMETRIC MEASUREMENTS

1. Linear Measurement

a. The student should be able to use formulas to find the perimeter of a square, rectangle, and triangle.

Perimeter = sum of all sides.

(1) Rectangle: $P = 2L + 2W$

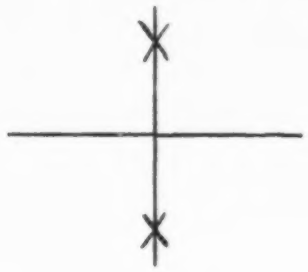


b. The student should be able to measure a line segment to the nearest $\frac{1}{8}$ and $\frac{1}{16}$ of an inch.

(1) _____ Give length in both units: to nearest $\frac{1}{8}$ = _____ and to nearest $\frac{1}{16}$ = _____.

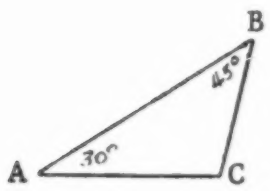
c. The student should be able to bisect a line segment, construct a line perpendicular to a given line using a compass.

(1)



d. The student should be able to measure or calculate the missing angle of a given triangle.

(1)



$\angle C = \underline{105^{\circ}}$.

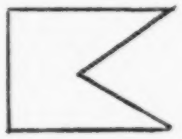
IX. DESCRIPTION OF THE PROGRAM (Continued)

E. GEOMETRIC MEASUREMENTS (Continued)

2. Area Measurement

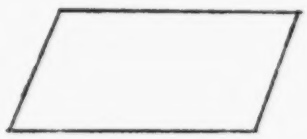
a. The student should be able to identify plane geometric figures: parallelograms, rhombus, convex and concave irregular polygons.

(1)



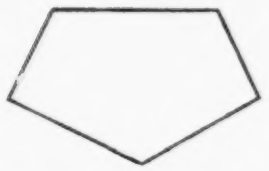
concave

(2)



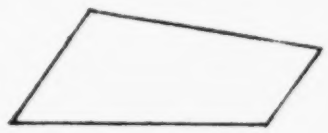
parallelogram

(3)



irregular convex polygon

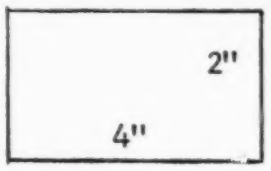
(4)



irregular convex polygon

b. The student should be able to find areas of: rectangle, circle, triangle, and parallelogram.

(1)

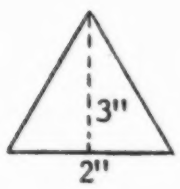


A = 8 sq. in.

(2)

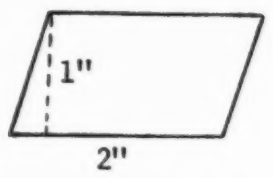
A ≈ 3.14 sq. in.

(3)



A = 3 sq. in.

(4)



A = 2 sq. in.

IX. DESCRIPTION OF THE PROGRAM (Continued)

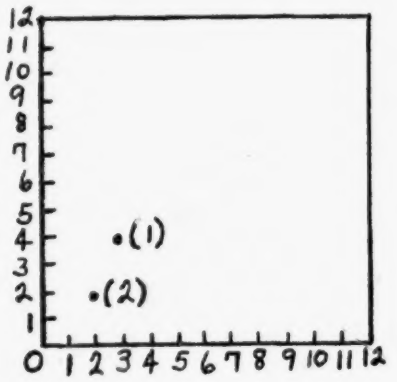
E. GEOMETRIC MEASUREMENTS (Continued)

2. Area Measurement (Continued)

c. The student should understand ordered pairs and be able to locate given coordinates.

(1) Find (3, 4)

(2) Find (2, 2)



3. Volume Measurement

a. The student should be able to find volume of familiar solids such as cubes, cylinders, and rectangular boxes.

(1) A cube having a side of 5 centimeters has a volume of 125 cubic centimeters.

(2) A box has these dimensions: length, 6 inches; width, 4 inches; and height, 3 inches. What is its volume? 72 cubic inches.

(3) Volume of a cylinder is found by using the formula: $V = \pi r^2 h$. Find the volume of a cylinder with a radius of 3 inches and a height of 6 inches.

$V = 54\pi$ cubic inches.

F. MATHEMATICS IN DAILY LIFE

1. The student should be able to apply the skills of measurement involving length, area, volume, in practical situations.

a. How many feet of fencing is needed to enclose a rectangular lot of given dimensions: 75' x 120'. 390 feet.

IX. DESCRIPTION OF THE PROGRAM (Continued)

F. MATHEMATICS IN DAILY LIFE (Continued)

1. b. How many square yards of carpet are needed to carpet a room 15' x 21', if nine square feet equal one square yard?

__35__ square yards.

c. A hole is to be dug with the following dimensions: 9' x 3' x 3'. How many cubic yards of dirt must be removed if one cubic yard is equal to twenty-seven cubic feet?

__3__ cubic yards.

2. The student should be able to change one unit of measure to another.

a. Change 3 feet 5 inches to inches. __41__ inches.

b. Change 2 hours 40 minutes to minutes. __160__ minutes.

c. Change 5 gallons 3 quarts to quarts. __23__ quarts.

d. Change 1 ton 400 pounds to pounds. __2400__ pounds.

3. The student should be able to maintain a check book balance.

a. Joe Doe deposited $172.65. He made two withdrawals of: $16.31 and $47.89. What is his balance? __$108.45__.

4. The student should be able to figure cost of installment buying.

a. Bill Brown bought a color T.V. which cost $489.95. He paid $45.00 down and agreed to pay $31.60 per month for 18 months. How much extra did he pay in interest and finance charges?

__$123.85__.

5. A student should have experiences in determining bargains in advertising copy.

a. Which of the following is the better buy?

(1) Shoes regularly priced at $7.99 on sale for $4.95,

or

(2) Shoes regularly priced at $7.99 on sale 2 pairs for $9.50.

(Assume shoes in above problems to be of equal value.)

IX. DESCRIPTION OF THE PROGRAM (Continued)

F. MATHEMATICS IN DAILY LIFE (Continued)

6. The student should be able to write sales orders.

a. Bill Jones works at B. J. Burger Hut. A customer ordered the following: 2 hamburgers, 1 fishwich, 1 strawberry shake, 1 large coke, 1 order French fries. (Don't forget to figure sales tax.) Student will fill this in:

B.J. Burger Hut

Price per Item	Items	No. of items	Cost
35¢	Hamburger		
40¢	Cheeseburger		
45¢	Fishwich		
25¢	French Fries		
25¢	Milk shakes ___ Strawberry ___ Chocolate ___ Vanilla		
20¢ 15¢	Cokes large ___ small ___		
10¢	Coffee		
	Sub total		
	Tax 4%		
	TOTAL		

IX. DESCRIPTION OF THE PROGRAM (Continued)

F. MATHEMATICS IN DAILY LIFE (Continued)

7. The student should be able to determine which purchase represents the best buy.

   a. Chicken soup regularly sells for 14¢ per can; but on sale, at 6 cans for 75¢. How much can be saved by purchasing 12 cans on sale?

   b. A 16 oz. box of crackers costs 18¢. A 32 oz. box of the same brand costs 39¢. Which box would be the better buy?

8. The student should be able to enlarge and decrease recipe amounts.

   a. A recipe calls for $\frac{3}{4}$ cup of rice, 1 can of onion soup, 1 small can of mushrooms, ½ stick of margarine, and ¼ cup of water. Serves 4. You wish to serve 8. How much of each ingredient would be needed?

   b. A recipe to serve 8 calls for: 2 pounds of round steak, ½ pound of sausage, 1 onion chopped, 1 tablespoon Worchester sauce, ¼ teaspoon salt. You want to serve 4 people. How much of each ingredient would be needed?

9. The student should be able to plan a simple personal budget.

   a. John has an income of $39.83 per week. He has the following fixed expenses:

School lunches	$ 3.50
Dry cleaning	2.00
Gas for car	4.00
School supplies	2.50
Savings	6.00

   How much does he have available for other than fixed expenses?

   b. Jean has an income of $29.34 per week. Her fixed expenses are:

Cosmetics	$ 5.00
School lunches	2.60
Dry cleaning	1.40
School supplies	2.30
Savings	6.45

   How much does she have left for other expenses?

X. RECOMMENDATIONS FOR EQUIPPING A SECONDARY MATHEMATICS LABORATORY CLASSROOM: LOW PHASES

The following teachers are to be commended for their many efforts in compiling the list:

Main Contributors:

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Jane Chaney	Merritt Island High
Ron Curtis	Kennedy Junior High
Dwight Haskins	Eau Gallie High
Eileen Pracek	Jackson Junior High
Nell Talcott	Satellite High

Other Contributors:

Egon Amarant	Cocoa High
William Averill	Titusville High
Stacey Barney	Satellite High
Betty Cartland	Cocoa Beach High
Joe Caruso	Cocoa High
Merle Cureton	Roosevelt Junior High
Linda Dudley	Hoover Junior High
Mary Golden	Pineda Elementary
Joe Gregory	Edgewood Junior High
David Hawkins	Clearlake Junior High
Paul Haynes	Jefferson Junior High
Wortham Heard	Parkway Junior High
Margaret Jenkins	Madison Junior High
Thomas Marquis	DeLaura Junior High
Hattie Nunn	Melbourne High
Janet Robertson	Titusville High
Jim Riley	Jefferson Junior High
Mabel Rooks	Southwest Junior High
Ralph Ross	Central Junior High
Ruth Strickland	Gemini Elementary
Samuel Thompson	Johnson Junior High
Nancy White	Stone Junior High

Consultant - Dr. Jack Foley	Florida Atlantic University
Mr. Thomas G. Etheredge, Jr.,	Director of Instruction (Central Area)

X. RECOMMENDATIONS FOR EQUIPPING A SECONDARY MATHEMATICS LABORATORY CLASSROOM: LOW PHASES (Continued)

This is a tentative list of math-lab items for equipping a classroom for low phases. The list is comprised of two categories - Essential and Desirable. It is suggested that a classroom be equipped with essential items before considering those listed as desirable. As funds permit, the math-lab classroom can be expanded to include desirable items.

This list was compiled by classroom teachers and, as noted, is tentative. Classroom teachers and department chairmen are encouraged to recommend items to be included on this list and also to recommend shifting items from one category to another. These recommendations should be submitted to the respective Director of Instruction (Area).

Some of the prices quoted in this listing are current at this printing; however, some are approximated. All prices are subject to change without advanced notice.

X. RECOMMENDATIONS FOR EQUIPPING A SECONDARY MATHEMATICS LABORATORY CLASSROOM: LOW PHASES (Continued)

A. ESSENTIAL

Instructional Materials

Item	Quantity	Unit Price	Total	Vendor
1. Protractors (4") Plastic	60	.10	6.00	1
2. Maple Rulers Cent. - Inch	60	(dz).60	3.60	4
3. Maple Meter Stick	15	.75	11.25	5
4. Compasses w/Screwdriver in Wooden Rack	30	.38	11.40	1
5. RGS 100 Rectangular Graph Stamp	1	2.75	2.75	1
6. GS 115 Grid Stamp (4 to inch)	1	2.75	2.75	1
7. BS-145 Check Stub Stamp	1	2.75	2.75	1
8. BS-140 Check Stamp	1	2.75	2.75	1
9. PS-175 Protractor Stamp	1	2.75	2.75	1
10. BS-165 Deposit Ticket Stamp	1	2.75	2.75	1
11. P-200 3¼ x 6¼ Ink Pads	2	1.25	2.50	1
12. 1-800 Roll on Bottles Ink (2 black-1 red)	3	.80	2.40	1
13. Chalk Board Compass	1	1.95	1.95	1
14. Chalk Board - T-Square 24"	1	2.50	2.50	1
15. Abacus (Computing Type)	1	4.50	4.50	4
16. J-9088 Solid Wooden Models	1	27.75	27.75	2
17. Slide Rules (Sterling) 9" Plastic	30	1.25	37.50	5
18. TF-01306 Protractor (Transparencies)	1	3.50	3.50	2
19. TF-01301 Ruler (Transparencies)	1	7.70	7.70	3
20. Plain Cubes	2	3.25	6.50	3
21. Z-3951 Board Protractor	1	6.50	6.50	1
22. Computational Skills Development Kit (SRA)	1	75.34	75.34	6
23. Transparent Sheets (per 1000)	1	25.00	25.00	7
24. Elementary Geometry Charts	1	10.00	10.00	8
25. Napiers Rods #784 1 Set	1	4.50	4.50	8
26. #760 Dissectible Cubic Foot	1	4.25	4.25	8
27. #89714 Solo Adder	3	8.98	26.94	13
28. 3 Sets Filmstrips for Controlled Reader a) AR-FX EDL Arith. No. Facts 1-12 b) ML-AR EDL Mental Arith. 3-12 c) AR-(grade level you wish) Arithmetic Story Problems	3	75.00	225.00	16
29. Geo. Boards 10" sq. (81 nails) 1" apart	30		County Maintenance	
30. Scissors 5" #231 S	2 dz.	2.50	5.00	8
31. Colored Projection Pens-Asst. Colors (doz)	2 dz.	6.00	12.00	8
32. Flow Charting Templates	30	.30	9.00	--
33. Pair of Dice	30	.30	9.00	31
34. Fraction Chart	1	2.00	2.00	8
35. Fraction Line Set	1	7.50	7.50	8
36. Transparent Slide Rule (CI scale)	1	10.00	10.00	4
37. 50' Tape	1	4.50	4.50	4
38. Chalk Board T-Square	2	2.50	5.00	1
39. Demo. Slide Rule Z-3049	1	35.00	35.00	4
40. New Math Flash Cards				
Addition #786	2	1.50	3.00	29
Subtraction #787	2	1.50	3.00	29
Multiplication #788	6	1.50	9.00	29
Division #789	6	1.50	9.00	29

X. RECOMMENDATIONS FOR EQUIPPING A SECONDARY MATHEMATICS LABORATORY CLASSROOM: LOW PHASES (Continued)

ESSENTIAL (Continued)

Instructional Materials (Continued)

Item	Quantity	Unit Price	Total	Vendor
41. New Math Relationship Cards				
Addition & Subtraction #790	2	1.50	3.00	29
Multiplication & Division #791	2	1.50	3.00	29
42. Blank Tapes (for recorder)	12	----	----	--
43. R-195 Ruler Stamp (in. 16M & cm)	1	2.75	2.75	1
44. BS-155 Receipt Stamp	1	2.75	2.75	1
45. BS-160 Sales Slip Stamp	1	2.75	2.75	1
46. The Math Wizard	1	3.50	3.50	12
47. Games for Learning Math	1	3.50	3.50	12
48. Cross Number Puzzles	1	3.50	3.50	12
49. LSI Arithmetic Fundamentals Advanced Assortment	1	69.00	69.00	34
50. Pkg. of 35 CTBS Arithmetic Tests Q-3 #CBA-3	1	5.30	5.30	34
SUB TOTAL			745.13	

Equipment

*1. Fully Automatic Print Out Calculator (Monroe Classmate or comparable)	1	595.95	595.95	9
2. Filmstrip and Slide Projector (Graflex or comparable)	1	63.50	63.50	14
3. Tape Recorder -(Concord 220 or comparable)	1	97.96	97.96	15
4. Listening Stations (Set of 8)	1	36.90	36.90	15
5. Controlled Reader	1	275.00	275.00	16
6. Overhead Projector (Bessler with fan)	1	57.39	57.39	Bid 15
7. Corner Mount Projection Screen	1	30.00	30.00	--
8. Typewriter with Math Keyboard	1	175.00	175.00	--
9. Cyclo-Teacher Machine	3	12.75	38.25	32
80 Study Wheels (Math)	2	14.55	29.10	32
Teacher Manual	1	1.20	1.20	32
2 Answer Wheel Pads (150 sheets each)	1	2.49	2.49	32
SUB TOTAL			1,402.74	

* The recommendation is made that additional calculators of this type be added as funds permit.

Furniture

1. Trapezoidal Tables	16	30.00	480.00	--
2. Student Chairs 17"	32	6.15	196.80	Bid 56
3. Large Cafeteria-type Table (approx. price)	1	40.00	40.00	--
SUB TOTAL			716.80	

X. RECOMMENDATIONS FOR EQUIPPING A SECONDARY MATHEMATICS LABORATORY CLASSROOM: LOW PHASES (Continued)

ESSENTIAL (Continued)

Academic and Strategy Games

Item	Quantity	Unit Price	Total	Vendor
1. Qubic	3	3.00	9.00	18
2. Tangrams	3	2.00	6.00	18
3. Winning Touch	3	4.00	12.00	8
4. Soma Puzzle	1	2.25	2.25	31
5. Kalah MGP-4	3	3.00	9.00	31
6. F-803-112 Wooden Puzzle Set	1	3.95	3.95	22
7. Krypto Game	5	1.25	6.25	31
8. Heads Up	3	5.00	15.00	31
9. Triominoes	2	3.95	7.90	22
10. Twixt	3	7.95	23.85	22
11. Score Four	1	4.95	4.95	22
12. Switch (Kohner)	3	1.00	3.00	33
13. HI Q (Kohner)	5	1.00	5.00	33
14. Spirographs	2	3.98	7.96	11
15. Multipuzzle from England	3	1.59	4.77	18
16. Chess Set with Beginning Book	1	4.95	4.95	22
17. Checkers:				
Wooden Checkers	4	.15	.60	8
Heavy Duty Boards	4	.29	1.16	8
18. Fractional Dominoes	1	3.00	3.00	28
19. Checkline (Like Qubic)	3	4.00	12.00	31
20. Revers'em (peg puzzle) 1002	5	1.00	5.00	30
21. Restack'em (peg puzzle) 1003	5	1.00	5.00	30
22. Mental Blox (6" triangle with golf tees) 1001	5	1.00	5.00	30
23. Quizmo				
Addition & Subtraction 9309	1	----	----	27
Multiplication & Division 9310	1	----	----	27
24. Yahtzee	2	2.29	4.58	18
25. #K823-178 Numble	2	4.00	8.00	22
26. Quinto	1	7.95	7.95	22
27. Battleship	3	5.00	15.00	22
	SUB TOTAL		193.12	

ESSENTIALS:

A) Instructional Materials	745.13
B) Equipment	1,402.74
C) Furniture	716.80
D) Games	193.12

GRAND TOTAL - $3,057.79

X. RECOMMENDATIONS FOR EQUIPPING A SECONDARY MATHEMATICS LABORATORY CLASSROOM: LOW PHASES (Continued)

B. DESIRABLE

Instructional Materials

Item	Quantity	Unit Price	Total	Vendor
1. Vernier Caliper (Demonstration)	1	16.50	16.50	1
2. Engineer's Rule	5	1.00	5.00	1
3. Architect's Rule	5	1.00	5.00	1
4. No. 200 2" Ring Binder	1	6.95	6.95	1
5. RS-190 Ruler Stamp in 10th & 16th in.	1	2.75	2.75	1
6. CS-125 Circle Graph Stamp	1	2.75	2.75	1
7. RS-180 Ruler in 1/2, 1/4, and 1/8	1	2.75	2.75	1
8. Parallel Rule	1	5.50	5.50	1
9. Chalk Board Triangle	1	2.95	2.95	1
10. Chalk Board Straight Edge 36"	1	2.25	2.25	1
11. HG-0300 Coin Tossing Machine	1	3.00	3.00	2
12. Z-9141 Trapezoid for Overhead	1	18.25	18.25	4
13. Pythagorean Theorem for Overhead	1	6.00	6.00	4
14. 2" Font-Plastic Pin-Back Letters	2	10.50	21.00	8
15. 2" Font-Plastic Pin-Back Numbers	2	3.50	7.00	8
16. 2" Font-Plastic Pin-Back Math Symbols	1	4.50	4.50	8
17. $30^{o}/60^{o}$ 8" Triangle - Plastic	5	.75	3.75	1
18. $45^{o}/90^{o}$ 6" Triangle - Plastic	5	.75	3.75	1
19. Posters: Math Fun and Fact (Set)	1	3.00	3.00	12
20. Posters: Number Novelties (Set)	1	3.00	3.00	12
21. Introduction to Optical Illusions	1	1.50	1.50	12
22. One Hundred Mathematical Curiosities	1	3.50	3.50	12
23. Cone, Sphere, Cylinder (Sets)	2	6.40	12.80	4
24. Flannel Board	1	11.00	11.00	8
25. Fractional Parts (Circle)	1	1.25	1.25	8
26. Fractional Parts (Squares)	1	1.25	1.25	8
27. Math Transparencies (Fractions)	1	275.00	275.00	2
28. Micrometer (Demonstration)	1	10.95	10.95	1
29. #158 T Clinometer	1	9.00	9.00	10
30. #155 T Trundle Wheel	1	12.00	12.00	10
31. Liquid Measures, Metric	2	8.00	16.00	4
32. #79896 Materials Attribute Games	1	9.60	9.60	25
33. #18479 Teacher's Guide for Above	1	5.88	5.88	25
34. #18480 Problem Cards	1	8.80	8.80	25
SUB TOTAL			504.18	

Equipment

1. Copy Machine (Transparency)	1	250.00	250.00	--
2. Ditto Machine	1	150.00	150.00	--
3. Olivetti - Programma - 101 Desk Top Computer (or comparable computer)	1	3750.00	3750.00	--
4. Paper Cutter 18" x 18"	1	29.90	29.90	--
5. Test Scorer (IBM)	1	150.00	150.00	--
SUB TOTAL			4329.90	

X. RECOMMENDATIONS FOR EQUIPPING A SECONDARY MATHEMATICS LABORATORY CLASSROOM: LOW PHASES (Continued)

DESIRABLE (Continued)

Furniture

Item	Quantity	Unit Price	Total	Vendor
1. Individual Student Carrels (2 back-to-back)	3 Twin	93.00	279.00	Bid 61
2. Projection Table (Bretford OH39E)	1	35.29	35.29	Bid 45
SUB TOTAL			314.29	

Games

1. Make One (Garrard Pub.) or Come Out Even	3	1.25	3.75	17
2. Vector	1	6.00	6.00	22
3. Chinese Checkers	1	2.50	2.50	8
4. Math Designer	1	4.95	4.95	--
5. Decimal Fraction Dominoes	1	3.00	3.00	28
6. Tangle Angles	1	5.00	5.00	28
7. Add-In	1	Teacher Made		--
8. Universe	1	5.00	5.00	22
SUB TOTAL			30.20	

DESIRABLE

A) Instructional Materials	504.18
B) Equipment	4,329.90
C) Furniture	314.29
D) Games	30.20
GRAND TOTAL -	$5,178.57

X. RECOMMENDATIONS FOR EQUIPPING A SECONDARY MATHEMATICS LABORATORY CLASSROOM: LOW PHASES (Continued)

Code No.	C. VENDORS
1	Geyer Instructional Aids Company, Inc. 1229 Maxine Drive Fort Wayne, Indiana 46807
2	Math Master Labs, Inc. P. O. Box 310 Big Springs, Texas
3	Standard School, Inc. 1945 Hoover Court Birmingham, Alabama 35226
4	La Pine Scientific Company 6001 South Knox Avenue Chicago, Illinois 60629
5	Science Kit Box 69 Tonawanda, New York
6	Science Research Associates 259 East Erie Street Chicago, Illinois 60611
7	Joseph Newstat Division of Newstat Plastics 8501 Augusta Street Philadelphia, Pennsylvania 19152
8	Drago School Equipment 2920 N. W. 7th Street Miami, Florida 33125
9	Monroe International 66 North Atlantic Avenue Cocoa Beach, Florida 32931
10	REC Learning Materials Division Responsive Environments Corporation Lackawanna Avenue West Patterson, New Jersey
11	Cuisenaire Company of America, Inc. 12 Churon Street New Rochelle, New York 10805
12	J. Weston Walch Publisher Box 658 Portland, Maine 04104
13	Hanover House Hanover, Pennsylvania 17331

X. RECOMMENDATIONS FOR EQUIPPING A SECONDARY MATHEMATICS LABORATORY CLASSROOM: LOW PHASES (Continued)

VENDORS (Continued)

Code No.	Vendors
14	Southern Photo Supply (Bid 70-0-045) Eau Gallie, Florida 32935
15	Brandon's, Inc. P. O. Box 5519 Jacksonville, Florida 32207
16	Systems for Learning 51 West Washington Street Orlando, Florida 32801
17	Holt, Rinehart and Winston 383 Madison Avenue New York 17, New York
18	Miles Kimball 41 West Eighth Avenue Oshkosh, Wisconsin
19	Dolch Teaching Aids Garrard Press Champaign, Illinois
20	Edmunds Scientific Company 300 Edscarp Building Barrington, New Jersey 08007
21	H and M Associates Math Media Division Box 1107 Danbury, Connecticut 06810
22	F.A.O. Schwartz 314 Royal Poinciana Plaza Palm Beach, Florida
23	Krypto Corporation Products of the Behavioral Sciences, Inc. 1140 Dell Avenue Campbell, California
24	E. S. Lowe Company, Inc. 27 West 20th Street New York, New York 10011
25	McGraw-Hill Webster Division 680 Forrest Road, N. E. Atlanta, Georgia 30312

X. RECOMMENDATIONS FOR EQUIPPING A SECONDARY MATHEMATICS LABORATORY CLASSROOM: LOW PHASES (Continued)

VENDORS (Continued)

Code No.	Vendors
26	Central Scientific Supply Company 3232 11th Avenue, North Birmingham, Alabama
27	Milton Bradley Company 2945 Rogevo Road Jacksonville, Florida 32211
28	Responsive Environments Corporation 200 Sylan Avenue Englewood Cliffs, New Jersey 07632
29	Ideal School Supply Company 11000 South Lavergue Avenue Oak Lawn, Illinois 60453
30	Paris Manufacturing Company Savannah, Tennessee 38372
31	Creative Publications P. O. Box 328 Palo Alto, California 94302
32	Field Educational Publications, Inc. 609 Mission Street San Francisco, California 94105
33	Kohner East Patterson, New Jersey
34	CTB/ McGraw-Hill 1375 Peachtree Street, N. E. Atlanta, Georgia 30309